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FOREST RESEARCH NOTES
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ADDITIONAL DATA ON COLLECTING AND PROPAGATING THE SEEDS OF CALIFORNIA WILD PLANTS[1]

by

N. T. Mirov
Silviculturist

Since Research Note No. 18, "Collecting and Propagating the Seeds of California Wild Plants," was issued in December 1937, additional information on handling seeds of California species has been accumulated. This information is assembled in the following tabulation, which lists 178 different species, arranged alphabetically by genera. For each species, as in the previous paper, the following information is given in tabular form: Time of seed collection, approximate number of seeds per pound, days elapsed between sowing the seed and germination, highest germination percentage obtained, and suggestions for any necessary treatment of the seed. With 254 species listed in Research Note No. 18, the total number of plants whose propagation has so far been investigated by this Station is brought up to 432.

For the technique of treating difficult seeds the reader is referred to Research Note No. 18, in which the subject is fully discussed.

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[1] In the preparation of material for this publication, James B. Roof, nursery technician of this Station, conducted most of the germination tests and assisted in the preparation of the tabulation. The names of the plants were checked by Mrs. Lois H. Marion of the California Forest and Range Experiment Station. Everett Doe, at one time an NYA student assistant at the Station, was responsible for estimating the number of seeds per pound for most of the species listed.

for Division of Information and Education

A further comment should be made on collecting seeds of wild plants, with particular reference to paragraph 3, page 3 of Research Note No. 18, in which a suggestion is made that sometimes it is convenient to collect seeds from native plants cultivated in the gardens. Frank F. Gander, Curator of Botany, Natural History Museum, San Diego, Calif., writes that in cultivation a native species like *Ceanothus cyaneus* blooms over a longer period of time than it does under natural conditions and thus is brought into contact with other blooming species. Accordingly, hybridization of native plants occurs more readily in cultivation than in the wild. This caution might well be kept in mind when seeds are collected from wild plants growing in gardens. Mr. Gander kindly permitted us to include in this publication a list of native plants successfully grown by him from cuttings and offshoots. This list, as submitted by Mr. Gander, is as follows:

Atriplex hymenelytra
Clematis ligusticifolia
Encelia californica
Frankenia Palmeri
Frankenia grandifolia
Heuchera brevistaminea
Lathyrus splendens
Lotus argophyllus
Lupinus Brittonii
Mimulus aridus
Mimulus cardinalis
Mimulus guttatus
Mimulus longiflorus
Mimulus longiflorus var. linearis
Mimulus puniceus
Monardella viminea
Oenothera californica
Penstemon ambiguus var. Thurberi
Penstemon Bridgesii
Penstemon centranthifolius
Penstemon Clevelandii
Penstemon labrosus
Penstemon spectabilis
Potentilla Bolanderi var. Clevelandii
Potentilla glandulosa
Potentilla gracilis
Potentilla truncata
Rhus laurina (took over 1 year to root)
Salvia Clevelandii
Salvia sonomensis
Satureja Chandleri
Solidago californica
Trichostema lanatum
Venegasia carpesioides
Zauschneria californica
Z. latifolia var. Johnstonii

The germination percentage shown in the tabulation on pages 4 to 7 is the highest obtained during the experiments. Sometimes it is very low, probably on account of poor quality of the seed tested. Better results might be obtained with different seed lots.

Stratification of the seeds was performed at 40° F., unless otherwise indicated.

Two California wild plants, *Isomeris arborea*, mentioned in Research Note No. 18, and *Simmondsia californica*, included in the present tabulation, are outstanding species and deserve a passing remark.

Isomeris arborea is a monoploid plant having 17 chromosomes and is reproduced asexually. Contents of the pollen tube are not released into the embryo sac but become enclosed in a thick wall. The embryo of the seed develops from one of the monoploid endosperm cells in a purely vegetative way.2/

Seed oil of *Simmondsia californica* does not consist of fats (i.e., tri-glycerides of fatty acids) as in all other plants so far investigated, but consists almost entirely of liquid wax (i.e., an ester composed of one molecule of a high molecular weight alcohol combined with one molecule of a high molecular weight acid). The *Simmondsia* seed oil is thus almost identical in composition with whale sperm oil, although it does not have the disagreeable fishy smell. It could be used to great advantage in the manufacture of cosmetics and for lubrication of delicate mechanism.

2/ Billings, Frederick H. Some new features in the reproductive cytology of angiosperms, illustrated by Isomeris arborea. New Phytologist 36: 301-326, illus. Oct. 1937.

Germination data of some California wild plants.[3/]

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Abronia umbellata pink sandverbena	June 1- Aug. 15	116,500	12	24	No treatment.
Abronia villosa woolly sandverbena	Oct.	159,000	8	41	No treatment.
Acer circinatum vine maple	Sept.- Oct.	5,000 Samaras	107	3	2 months' stratification at 40° F. Use fresh seed.
Acer glabrum Rocky Mountain maple	Aug.- Oct.	13,000 20,000 Samaras	98	4	3 months' stratification. Use fresh seed.
Acer negundo var. californicum California boxelder	Sept.- Oct.	10,000	98	60	3 months' stratification.
Adenocaulon bicolor	Aug.-	84,900	44	52	No treatment.
Agropyron subsecundum bearded wheat grass	Sept.	398,000 dry	10	2	No treatment. Percentage of germination should be much higher.
Amelanchier alnifolia common serviceberry	July- Sept.	5,100 dry berries 95,400 seeds	93	50	Stratify 3 months at 0° C. in peat sand, using fresh seed.
Amorpha fruticosa indigobush	Aug.- Sept.	55,000 60,000	8	41	No treatment.
Amsinckia douglasiana (buckthorn weed)	May- June	175,000	10	2	No treatment.
Andropogon saccharoides silver beardgrass	June- July	515,000	20	4	No treatment.

[3/] Scientific and common names are in accord with official Forest Service usage, where such is available. Names from other sources are enclosed in parentheses; those underscored are from Jepson's "Manual of the Flowering Plants of California."

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Antirrhinum glandulosum (sticky snapdragon)	Aug.	2,670,000	18	3	No treatment.
Antirrhinum speciosum (Catalina snapdragon)	July-Aug.	6,400,000	21	13	No treatment. Easily raised from cuttings.
Antirrhinum virga snapdragon	Sept.	2,060,000	18	81	No treatment.
Aquilegia pubescens columbine	Sept.		101	5	3 months' stratification.
Aquilegia tracyi columbine	May 15-June 15	214,400	68 18	21 34	3 months' stratification. Untreated. Germinate in shade.
Aquilegia formosa truncata California columbine	July-Oct.	204,000	98	32	2 months' stratification.
Arabis glabra (tower mustard)	June 15-July 15	Not determined	6	92	No treatment.
Arctostaphylos bicolor brittleleaf manzanita	June	24,300 berries			Species of genus Arctostaphylos usually require sulfuric acid treatments followed by a very prolonged stratification. However, they are easily propagated from cuttings especially when treated with root-inducing substances
Arctostaphylos glauca great manzanita	Aug.	560+ dry cleaned seed		0	
Arctostaphylos nevadensis pinemat	July-Sept.	3,820 clean dry berries	173	5	
Arctostaphylos pungens pointleaf manzanita	June	1,835 dry berries		0	
Arctostaphylos rudis (shagbark manzanita)	June	2,540 dry berries			

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Arctostaphylos viscida (white-leaf manzanita)	Oct.	1,920 dry berries	107 378	2 83	Stratified 12 months at 0° C. in peatmoss then sown in soil. 6-year old seed used.
Arenaria capillaris sandwort	Sept.	Not determined	35	3	No treatment
Arenaria douglasii sandwort	May 15-June 15	1,444,000	31	19	No treatment
Argemone platyceras crested pricklepoppy	Sept.	160,000	76	1	
Asclepias eriocarpa milkweed	June-July	25,200	10	40	No treatment.
Aster canescens	June	821,000	6	14	No treatment.
Aster tortifolius	June	Not determined	7	36	No treatment.
Astragalus bolanderi	Sept.	107,000	7	6	No treatment.
Astragalus menziesii	Oct.	Not determined	8	32	No treatment.
Atriplex canescens fourwing saltbush	Aug.-Sept.	31,600 clean-dry	8	14	No treatment. 60% germination was reported.
Atriplex hymenelytra (desert holly)	April-May		7	35	No treatment
Atriplex leucophylla	Aug.	Not determined	120	8	3 months' stratification.
Atriplex nuttallii (salt sage)	Aug.	Not determined	6	3	No treatment.
Atriplex polycarpa fanscale saltbush	Dec.	Not determined	7	7	No treatment
Balsamorhiza sagittata arrowleaf balsamroot	July 15-Aug. 15		26	2	No treatment.
Boykinia elata	Oct.	Not determined	18	6	No treatment.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Brickellia frutescens (rigid brickellbush)	June 15-July 15	494,500	3	36	No treatment.
Brodiaea capitata (blue dicks)	May 1-June 15	291,000	94	78	No treatment.
Brodiaea coronaria (harvest brodiaea)	June 15-July 15	Not determined	49	50	No treatment.
Bromus grandis	July 15-Aug. 15		9	71	No treatment.
Bromus rubens foxtail chess	May-July	203,900 In hulls out of head	17	46	No treatment.
Calyptridium monandrum	May 15-June 30	4,955,000	115	11	No treatment.
Ceanothus fresnensis (Fresno mat)	July	204,000	94	31	3 months' stratification.
Ceanothus impressus (veinyleaf ceanothus)	June	Not determined	91	73	Hot water treatment and 3 months' stratification
Ceanothus lemmonii Lemmon ceanothus	July	118,000	101	52	Hot water treatment and 3 months' stratification.
Ceanothus perplexans (cupleaf ceanothus)	June	65,990	95	49	Hot water treatment and 3 months' stratification.
Ceanothus tomentosus var. olivaceus (woollyleaf ceanothus)	May-June	120,000	13	65	Hot water treatment.
Cephalanthus occidentalis common buttonbush	Sept.-Dec.	11,800	23	5	No treatment.
Cercidium torreyanum blue paloverde	Oct.	3,170	7	24	No treatment.
Cercocarpus alnifolius (alderleaf mountain-mahogany)	Sept.	33,000 60,000	20	24	No treatment.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Cercocarpus minutiflorus (San Diego mountain-mahogany)	Aug.	32,200	11	84	No treatment.
Chaenactis artemisiaefolia	May 15-July 1	980,500	11	3	No treatment.
Chamaebatia foliolosa bearmat	Oct.	20,900 dry berries	95	51	3 months' stratification. Easily propagated by root cuttings.
Chamaebatiaria millefolium Tansybush	Oct.	2,270,000	3 92	57 85	No treatment. (Fresh seed gives best germination.) 3 months' stratification at 5° C.
Chilopsis linearis desertwillow	Aug.-Sept.	39,500	7	70	No treatment.
Chlorogalum pomeridianum (soap plant)	July-Aug.	45,200	21	86	No treatment
Clinopodium mimuloides	Oct.	856,600	19	55	No treatment.
Clintonia andrewsiana red clintonia	Aug.	50,000	186	60	No treatment. Germinate in shade.
Cneoridium dumosum (berryrue)	June	2,830	96	66	2 months' stratification.
Collinsia bicolor Chinese-houses	May-July 15	466,000	27	5	No treatment.
Comarostaphylis diversifolia (summer-holly	July-Aug.	16,000	94	78	3 months' stratification. Plain sown seeds also germinate fairly well.
Convolvulus occidentalis	June	63,000	10	32	No treatment.
Cordylanthus rigidus (mule-weed)	Oct. 4	Not determined	29	3	No treatment.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Delphinium cardinale cardinal larkspur	Aug.	Not determined	30	30	No treatment for fresh seed. Stored seed require 2 months' stratification.
Delphinium hansenii (Hansen larkspur)	May 15- July 30	876,000	56	39	No treatment.
Delphinium purpusii	May 15- June 20	486,000	63	72	2 months' stratification.
Dodecatheon jeffreyi Jeffrey shootingstar	Sept.	Not determined	28	3	No treatment.
Encelia frutescens (bush encelia)	June- July	207,800	4	47	No treatment. Raise in hothouse.
Enceliopsis covillei Panamint daisy	June	Not determined	7	17	No treatment.
Ephedra viridis (green ephedra)	July- Sept.	15,500	85	54	1 months' stratification. Plain sown seed germinate fairly well.
Epilobium paniculatum	Oct.	Not determined	4	54	No treatment.
Eremalche rotundifolia	June	Not determined	7	18	No treatment.
Eriogonum nudum barestem eriogonum	July- Oct.	612,000	11	41	No treatment.
Eriogonum rubescens (red-buckwheat)	July- Aug.	622,300	6	21	No treatment.
Eriogonum umbellatum sulphur eriogonum	Sept.	Not determined	20	23	No treatment
Erodium cicutarium alfileria	May- June	111,000	3	6	No treatment.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Euonymus occidentalis (western burning bush)	July-Oct.	Not determined	110	2	3 months' stratification.
Fritillaria biflora (mission bells)	June	103,000	56	55	No treatment.
Geraea viscida	June 25	125,000	7	7	No treatment.
Gnaphalium bicolor cudweed	May	Not determined	7	65	No treatment.
Gnaphalium chilense (cotton-batting plant)	July-Aug.	Not determined	5	100	No treatment.
Godetia bottae	July	1,420,000	4	16	No treatment.
Godetia viminea	June	1,420,000	5	85	No treatment.
Grayia spinosa (spiny hopsage)	April	582,000	15	4	No treatment.
Helenium puberulum (rosilla)	Sept. 1-Dec. 15	926,000	37	5	No treatment.
Helianthus aridus	Sept.	73,200	11	11	No treatment. A Colorado species.
Heuchera maxima	July-Aug.	10,490,000	10	47	No treatment. Germinate in shade.
Heuchera micrantha var. hartwegii	July		31	46	No treatment. Germinate in shade.
Hieracium albiflorum white hawkweed	Aug.	1,370,000	19	55	No treatment.
Lathyrus splendens (campo pea)	June-July	6,160	15	50	Hot water treatment.
Ledum glandulosum smooth Labrador-tea	Aug.-Sept.	Not determined	43	36	No treatment Seeds minute. Germinate in shade. Keep seed flats quite moist.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Lilium humboldtii var. ocellatum Humboldt lily	Oct.	48,000	108	34	3 months' stratification.
Linanthus bicolor	June	Not determined	35	62	1 month's stratification. Untreated seed probably will germinate well.
Linanthus serrulatus	May 20-July 1	582,500	4	28	No treatment.
Linum lewisii prairie flax	June 15-Sept. 30	163,400	10	63	No treatment.
Lonicera conjugialis (double honeysuckle)	Sept.	Not determined	99	35	3 months' stratification.
Lotus scoparius var. dendroideus (island deerweed)	June-Aug.	Not determined	6	54	No treatment.
Lotus eriophorus var. heermannii	Aug.	402,000	3	81	No treatment.
Lotus humistratus foothill deervetch	June-Aug.	Not determined	5	86	No treatment.
Lupinus albifrons (foothill bush lupine	June	16,800	3	43	No treatment[4].
Lupinus bicolor	May	141,000	8	20	Fresh seed germinate without treatment. Hot water treatment for stored seed.
Lupinus chamissonis Chamisso lupine	June	11,500	3	32	
Lupinus concinnus	May	186,000	13	16	No treatment. Probably could be improved by hot water treatment
Lupinus densiflorus	May-June-July	364,000	3	38	No treatment

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[4] Freshly collected seeds of lupines usually germinate well without treatment. Stored seeds require hot water treatment.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Lupinus excubitus var. austromontanus (Inyo lupine)	May 1-July 30	21,400	2	61	No treatment for freshly collected seed. Hot water treatment for stored seed.
Lupinus latifolius var. columbianus	Aug.	10,500	4	44	No treatment.
Lupinus latifolius var. parishii	June-July	17,600	5	22	No treatment.
Lupinus nanus common dwarf lupine	May	111,000	18	60	No treatment.
Lupinus polyphyllus Washington lupine	June	13,600	5	62	No treatment.
Lupinus variicolor (varicolored lupine)	June	Not determined	3	42	No treatment.
Lycium brevipes (desert thorn)	June	1,371,000	17	11	No treatment.
Maianthemum bifolium var. kamtschaticum (Oregon coltsfoot)	Oct.	24,100	53	38	No treatment.
Melica stricta rock melic	May-June	87,400	65	31	2 months' stratification.
Micromeria chamissonis (yerba buena)	Sept.		28	34	No treatment.
Mimulus bigelovii (desert mimulus)	June	Not determined	21	10	No treatment.
Mimulus floribundus	Oct.	Not determined	18	19	No treatment.
Mimulus guttatus (common monkey-flower)	June	Not determined	7	56	No treatment.
Mitella breweri	July	Not determined	108	62	No treatment.
Monardella lanceolata (mustang mint)	June 15-Aug. 30	908,000	6	91	No treatment.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Monardella villosa var. franciscana (coyote mint)	Oct.	Not determined	6	78	No treatment.
Montia perfoliata (miner's lettuce)	May-June	1,370,000	63	19	2 months' stratification.
Muhlenbergia microsperma littleseed muhly	Apr. 1-June 15	2,218,000 In hulls - out of head	23	7	No treatment.
Odostemon aquifolium Oregon grape	Sept.-Oct.	Not determined	100	46	3 months' stratification.
Orthocarpus attenuatus (valley tassels)	May 15-July 30	14,610,000	20	5	No treatment.
Orthocarpus purpurascens purple owlclover	May	2,840,000	160	10	2 months' stratification.
Pentstemon clevelandii (Cleveland pentstemon)	Oct.	Not determined	6	14	No treatment.
Pentstemon cordifolius heartleaf pentstemon	July 1-Aug. 30	1,904,000	8	37	No treatment.
Pentstemon corymbosus (red pentstemon)	Oct.	3,360,000	13	68	No treatment.
Pentstemon glaber blue pentstemon	July	833,000	9	55	No treatment.
Pentstemon grinnellii (Grinnell pentstemon)	July 15-Aug. 30	294,000	24	45	No treatment.
Pentstemon laetus (mountain blue pentstemon)	Sept.	Not determined	9	9	No treatment.
Pentstemon lemmonii Lemmon pentstemon	June 15-Aug. 30	2,337,000	17	28	No treatment.
Pentstemon rattanii	Oct.	1,020,000	82	3	No treatment.
Pentstemon spectabilis showy pentstemon	July 15-Sept. 15	551,000	12	14	No treatment.
Pentstemon ternatus (whorl-leaf pentstemon)	Sept.	1,050,000	20	31	No treatment.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Peucephyllum schottii (pigmy cedar)	June	Not determined	10	22	No treatment.
Phacelia crenulata	June	Not determined	14	47	No treatment needed.
Phacelia distans	July	561,000	34	2	No treatment needed.
Phacelia hispida (caterpillar phacelia)	June 15-July 15	504,800	11	6	No treatment.
Phacelia minor (California blue-bell)	July	1,510,000	20	6	No treatment.
Phacelia viscida var. albiflora	June 15-July 15	3,040,000	20	2	No treatment.
Phyllodoce breweri Brewer mountainheath	Aug.-Sept.	20,000,000 fanned	67	80	2 months' stratification; or sow in peat soil untreated fresh seed.
Piscaria setigera turkey-mullein	Oct.	Not determined	48	24	No treatment.
Poa bulbosa bulbous bluegrass	May-June	313,000	5	41	No treatment.
Polypogon monspeliensis rabbitfoot grass	May 1-July 30	5,830,000 Thrashed no hulls.	12	69	No treatment.
Porophyllum gracile (poreleaf)	June	755,000	1	12	No treatment.
Prunus lyoni Catalina cherry	Aug.-Sept.	312	113	7	3 months' stratification.
Psoralea macrostachya leatherroot	June-Sept.	26,300	4	98	No treatment.
Psoralea physodes California-tea	Aug.	15,000	42	100	No treatment.
Ptelea baldwinii var. crenulata California hoptree	Aug.	7,000	108	12	3 months' stratification.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Quercus oerstediana Brewer oak	Oct.	Not determined	22	46	Oak acorns should be sown the same fall they are collected, and between collecting and sowing, should be stored in a cool room in sacks and frequently inspected.
Quercus engelmannii Engelmann oak	Sept.-Oct.	Not determined	57	16	
Quercus garryana Oregon white oak	Sept.	100+	31	90	The samples were germinated in peat in deep boxes.
Quercus garryana var. semota (Kaweah oak)	Aug.-Sept.	Not determined	40	95	
Quercus morehus oracle oak	Oct.	Not determined	74	39	
Rhamnus californica var. obtusissima California buckthorn	Oct.	2,620	17	30	No treatment.
Rhamnus californica var. occidentalis California buckthorn	Oct.	Not determined	99	70	3 months' stratification.
Rhamnus crocea insularis great redberry buckthorn	Aug.-Sept.	3,640	97	27	3 months' stratification. Easily propagated from cuttings.
Rhus trilobata skunkbush	Sept. 15-Oct. 15	9,250 fruit 14,300 seed	40	42	Sulphuric acid treatment. 6 hours in acid gives best results.
Ribes sanguineum winter currant	Aug.	118,000	94	14	3 months' stratification.
Rosa californica var. ultramontana California wild rose	Aug.-Sept.	Not determined	74	62	3 months' stratification.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Salvia carduacea thistle sage	July-Aug.	Not determined	6	14	No treatment.
Sambucus caerulea blueberry elder	July 15-Oct. 30	27,400 dry berries	158	17	3 months' stratification with very fresh seed.
Sequoia gigantea giant sequoia	April-Dec.	95,000	58	42	No treatment.
Simmondsia californica jojoba	June	1,690	7	97	No treatment.
Solanum douglasii (Douglas nightshade)	June-Dec.	Not determined	8	74	No treatment.
Stipa speciosa desert needlegrass	May-June	172,000	22	23	No treatment.
Streptanthus tortuosus var. orbiculatus	Aug.	890,000	94	4	No treatment.
Thalictrum polycarpum Sierra meadowrue	July 1-Aug. 30	188,200	36-	6	No treatment. Probably stratification would be beneficial.
Thamnosma montanum (turpentine broom)	June	33,300	8	25	
Thermopsis macrophylla	July 15-Aug. 30	35,250	39	75	Hot water treatment.
Tofieldia occidentalis	Oct.	Not determined	49	7	No treatment.
Trichostema lanatum romero (woolly bluecurls)	June-July-Aug.	189,000	100	12	3 months' stratification at 32° F. Use old, stored seed; not fresh seed.
Vaccinium parvifolium red whortleberry	Oct.	1,560,000	122	9	Germinated in lath house.

Species	Time of seed collecting	Approximate number of seeds per pound	Days between sowing and germination	Highest germination percentage obtained	Treatment and culture
Vicia sativa common vetch	May 1- July 15	12,900	28	81	No treatment.
Wyethia angustifolia	Aug. 1- Sept. 30	49,000	69	25	2 months' stratification.
Wyethia glabra (mule-ears)	Aug.	30,100	44	6	2 months' stratification.
Zygadenus fremontii Fremont deathcamas	June	212,000	94	99	3 months' stratification.